IMPACTS OF DAM AND RESERVOIR PASSAGE ON OUTMIGRATING JUVENILE HATCHERY CHINOOK SALMON: RESULTS FROM A PAIRED RELEASE STUDY IN THE UPPER WILLAMETTE RIVER BASIN

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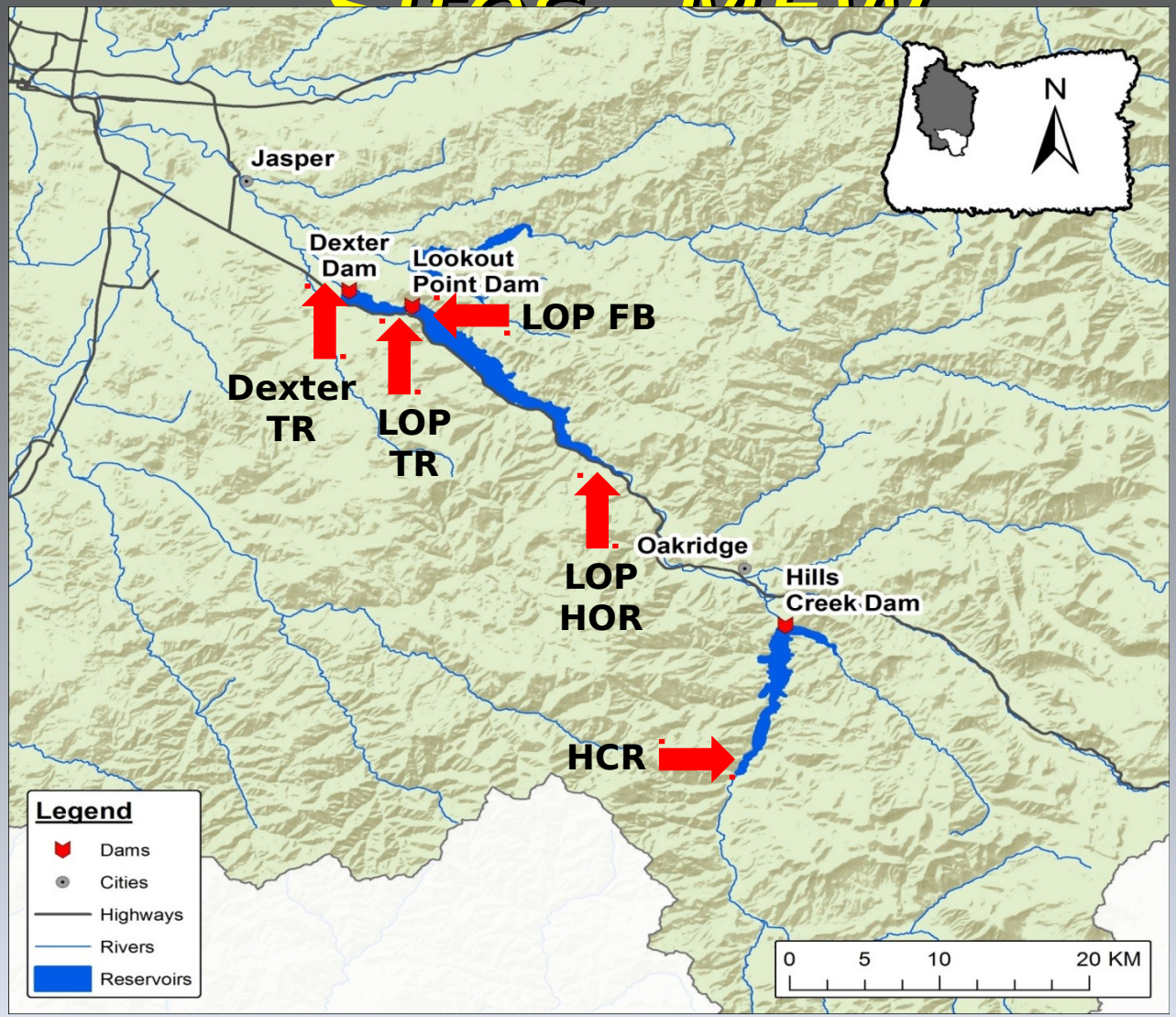
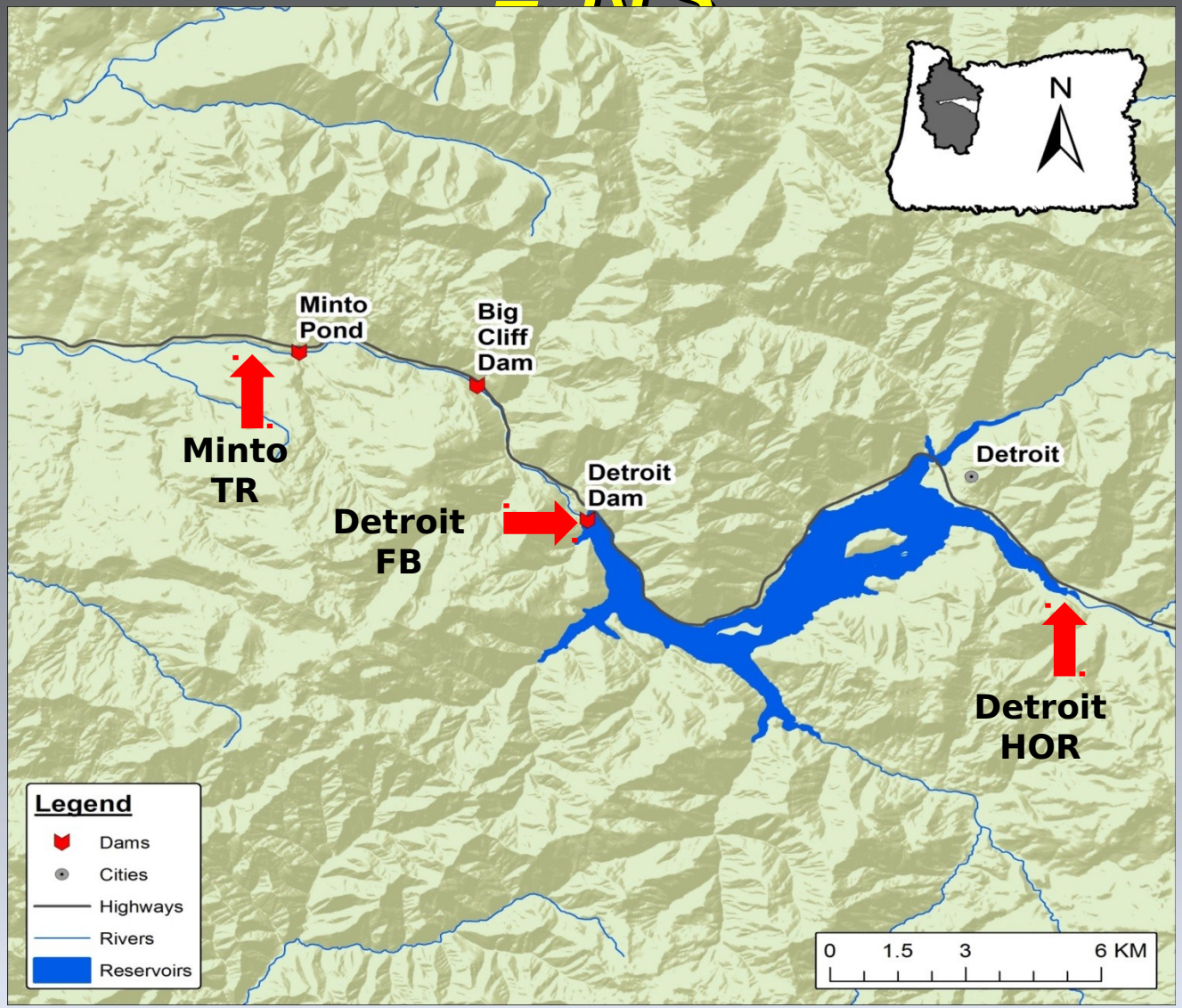
Objectives

- Estimate the effect that passage through dams and reservoirs in the Middle Fork Willamette and North Santiam rivers has on outmigration success (relative detection rate) of juvenile hatchery Chinook salmon
- Estimate the effect that passage through dams and reservoirs has on survivorship to adulthood for juvenile hatchery Chinook salmon
- Useful ancillary data: movement and growth rates of juvenile hatchery Chinook salmon released above and below dams

Study Area and Release Sites - MFW



Study Area and Release Sites – NS



Tagging & Release

- Hatchery fish used
- One-time yearly releases
- Major assumption: hatchery fish are phenotypically similar to naturally-produced fish entering the reservoirs (size, timing, behavior, condition, etc.)

Tagging & Release – MFW

	Release Location				
Release Year	Dexter TR	LOP TR	LOP FB	LOP HOR	HCR
2011	5,959	--	--	5,967*	--
2012	49,371	--	--	49,651	49,330
2013	37,299	--	37,310	37,200	33,301
2014	33,520	33,952	34,544	32,769	--

*200,673 CWT fish released in addition to PIT tags

Tagging & Release – NS

	Release Location		
Release Year	Minto TR	Detroit FB	Detroit HOR
2012	12,475*	--	12,465*
2013	33,299	33,246	33,208
2014	33,463	33,485	33,478

*75,069 total CWT fish released in addition to PIT tags

Detection & Recovery

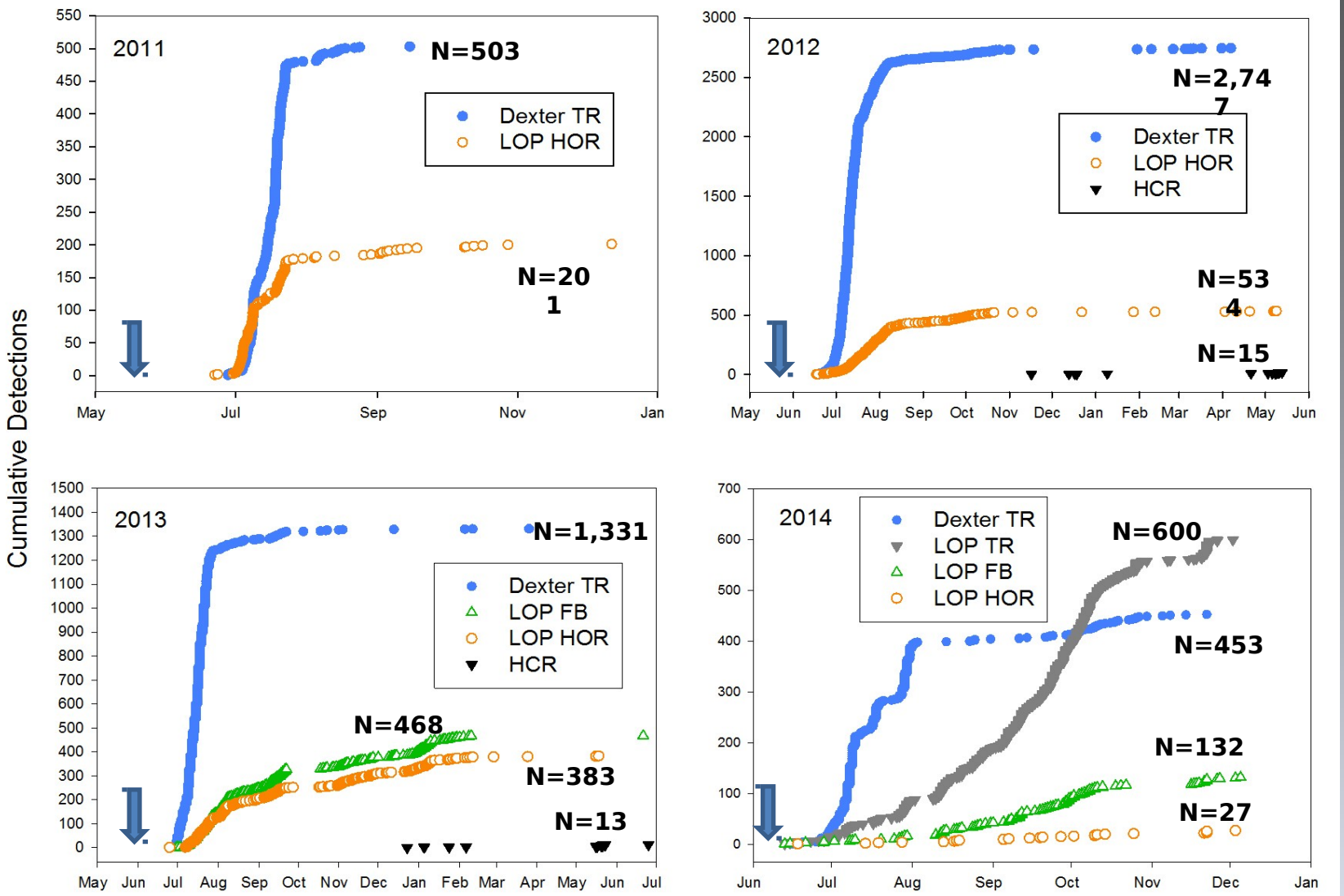
PIT tags (2011-2019):

- Outmigrants at Willamette Falls, detection efficiency <10%
- Adults at Willamette Falls, detection efficiency 100%
- Other researchers

CWTs (2013-2017):

- Fisheries, hatcheries, spawner surv

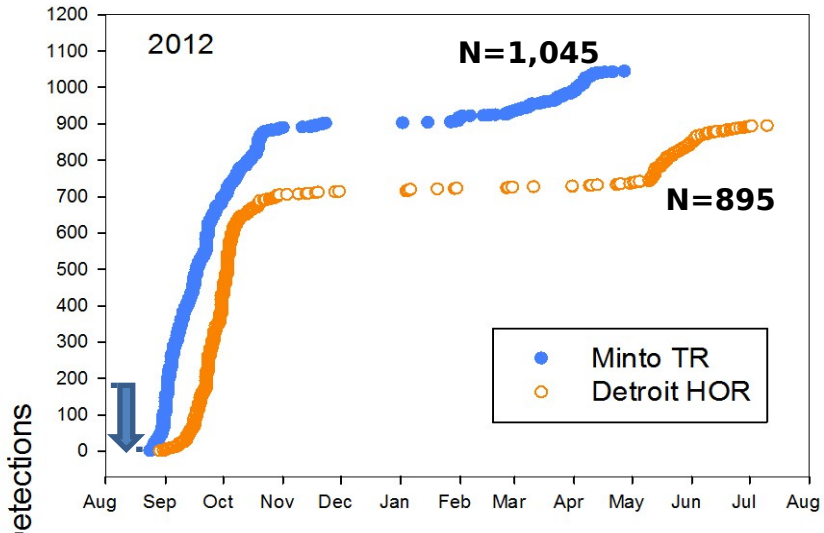
Outmigration Success– MFW

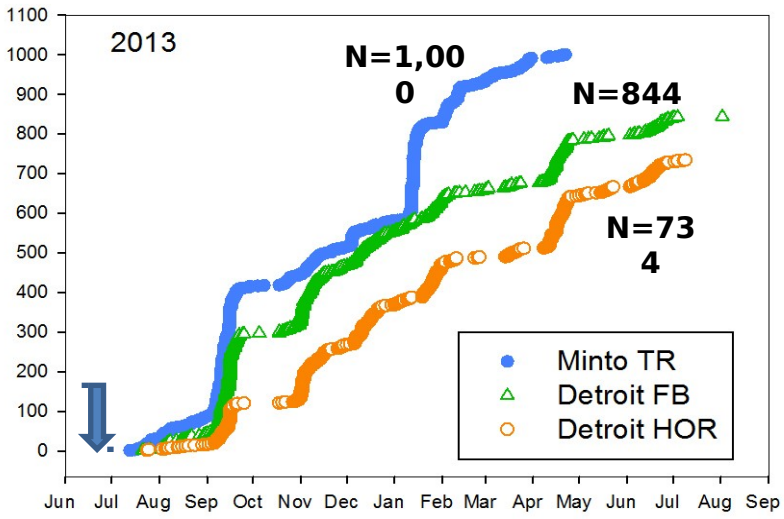


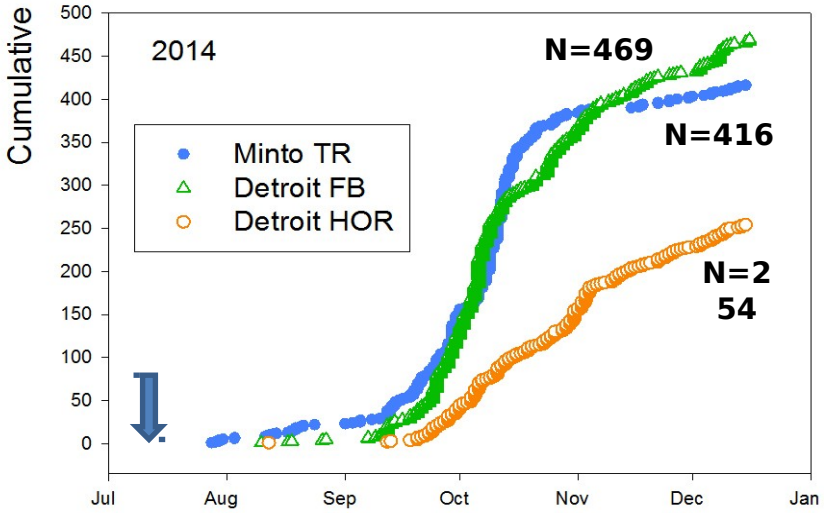
Relative Survival – MFW

Release Year	Release Location				
	Dexter TR	LOP TR	FB	HOR	HCR
2011	0.084[y]	n/a	n/a	0.034[z]	n/a
2012	0.056[x]	n/a	n/a	0.011[y]	3.0×10^{-4} [z]
2013	0.036[w]	n/a	0.013[x]	0.011[y]	3.9×10^{-4} [z]
2014	0.014[w]	0.018[x]	0.004[y]	8.2×10^{-4} [z]	n/a

Outmigration Success– NS



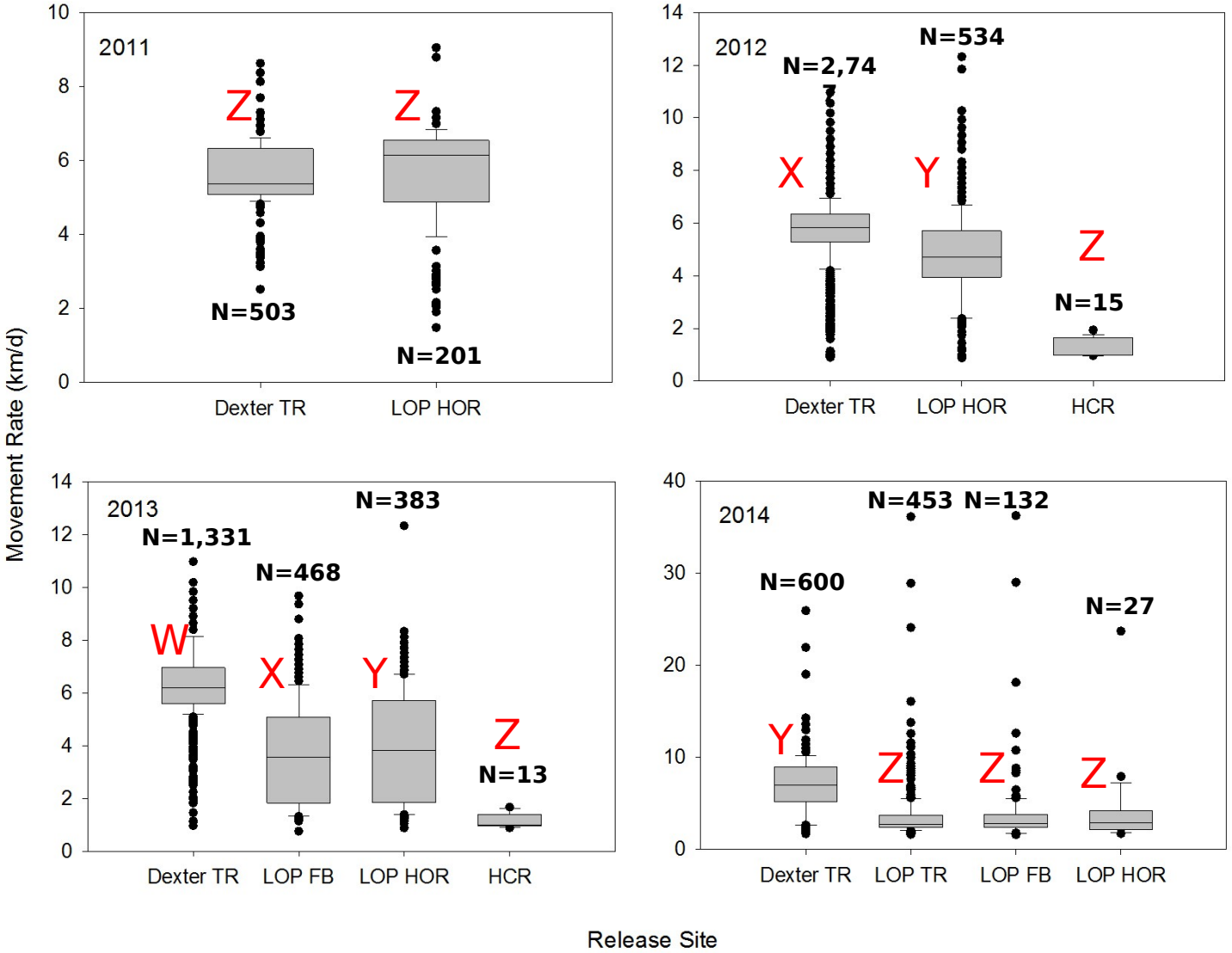




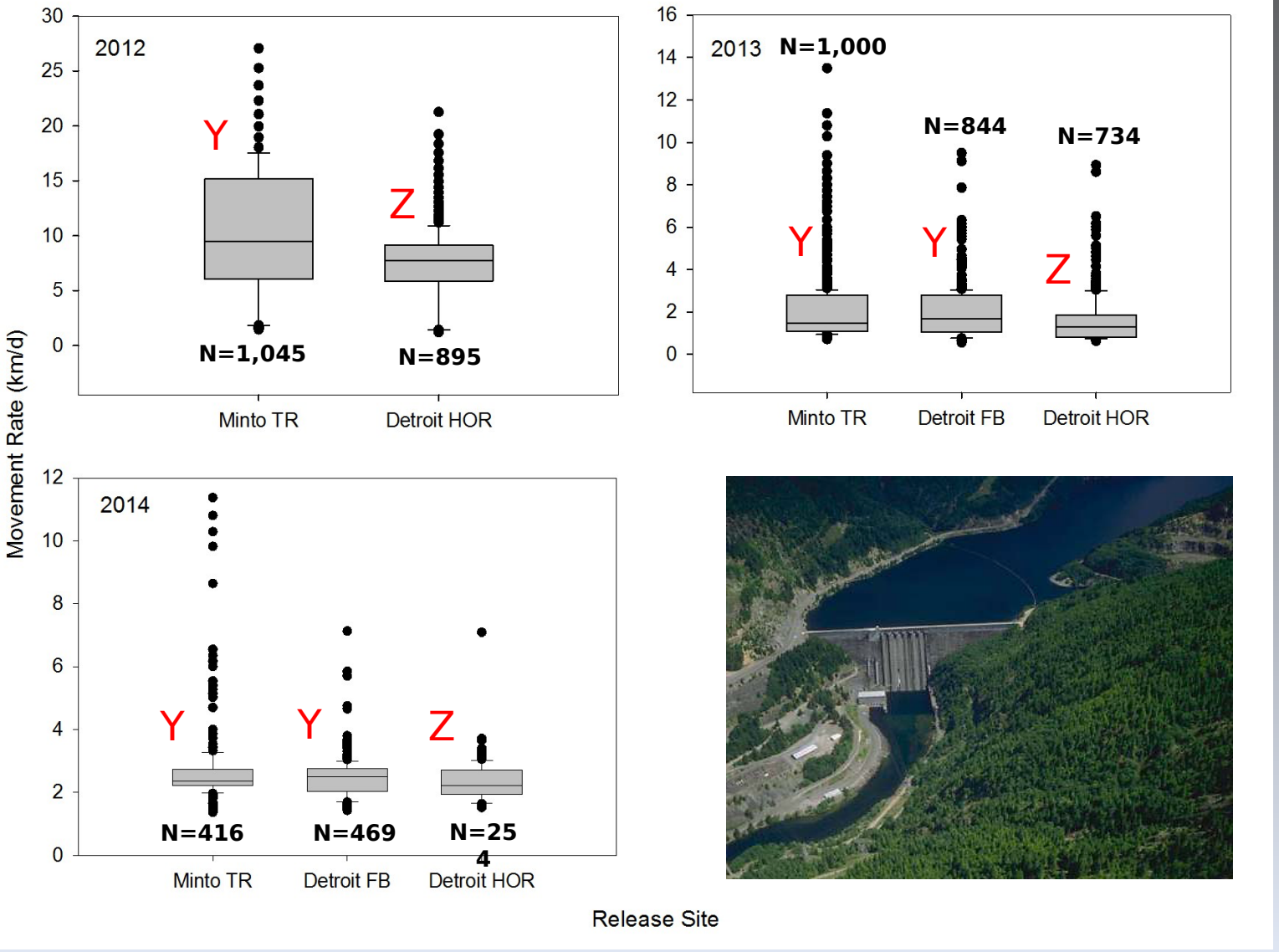
Relative Survival – NS

Release Year	Release Location		
	TR	FB	HOR
2012	0.084[y]	n/a	0.072[z]
2013	0.037[x]	0.029[y]	0.024[z]
2014	0.012[y]	0.014[y]	0.008[z]

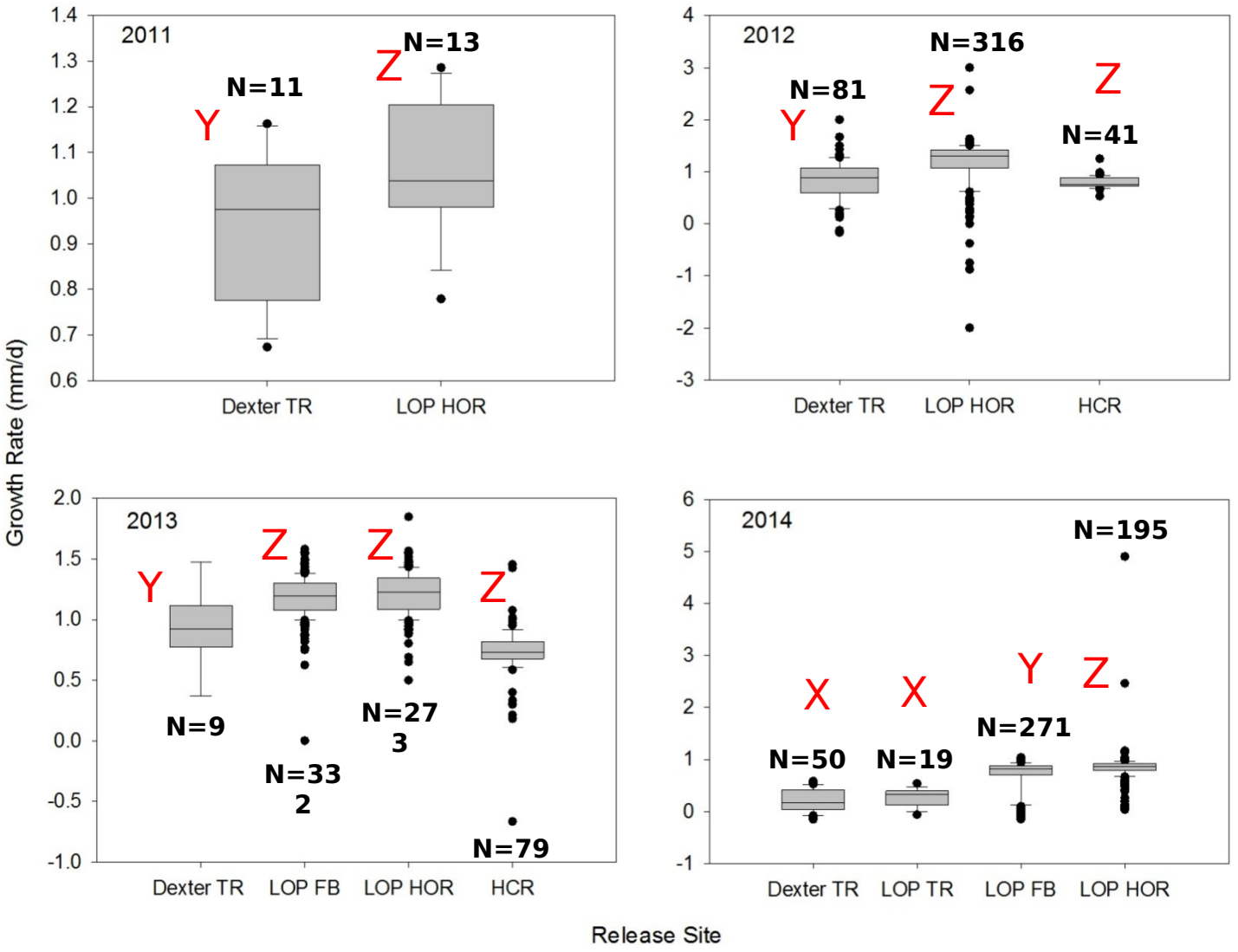
Movement Rate– MFW



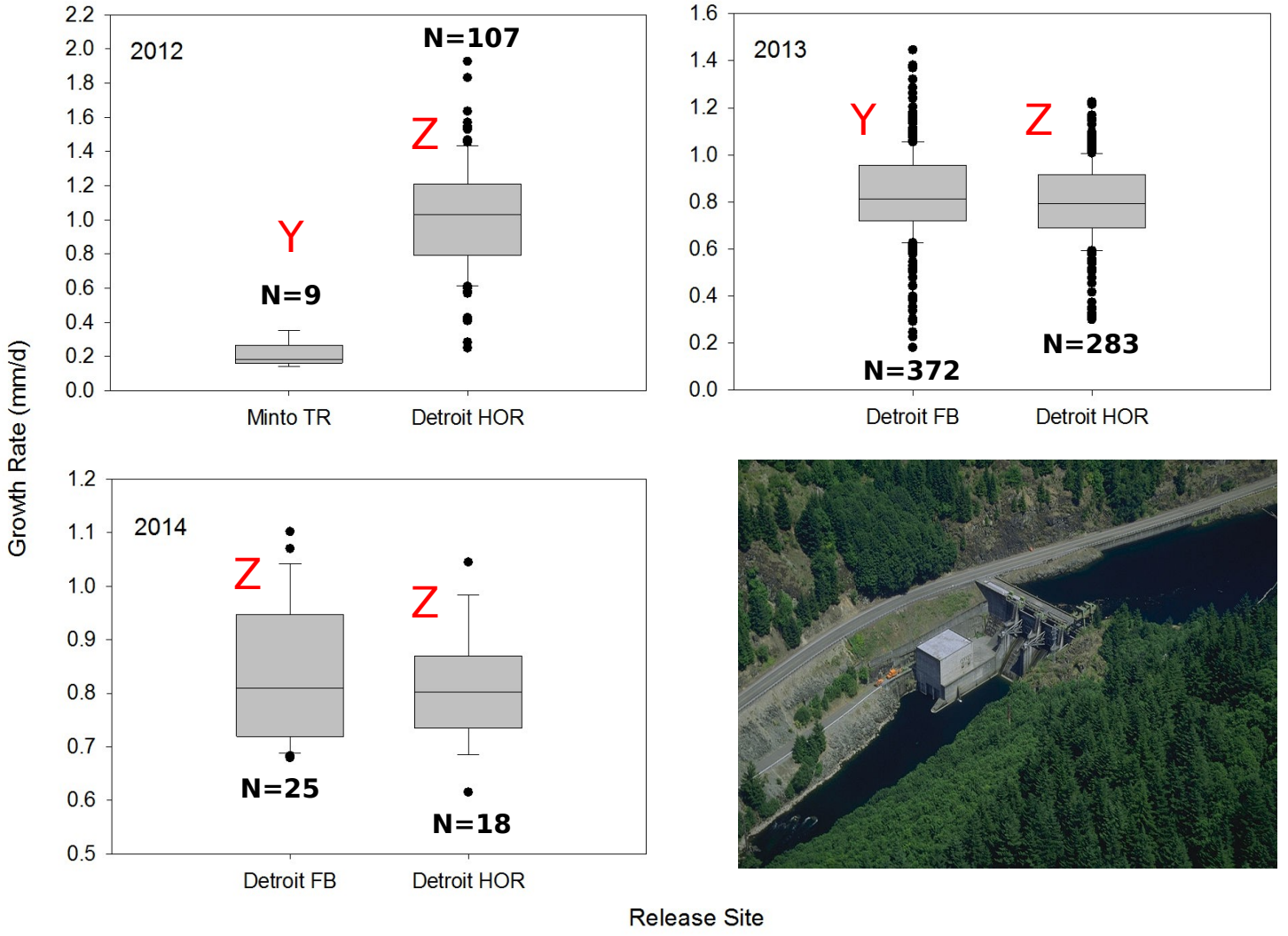
Movement Rate– NS



Growth– MFW


2011
N=11
Y
N=13
Z
Dexter TR
LOP HOR
2012
N=81
Y
N=316
Z
Z
N=41
Dexter TR
LOP HOR
HCR
2013
N=9
Y
N=33
2
Z
N=27
3
Z
Z
N=79
Dexter TR
LOP FB
LOP HOR
HCR
2014
N=50
X
N=19
X
N=271
Y
N=195
Z
Dexter TR
LOP TR
LOP FB
LOP HOR
Growth Rate (mm/d)
Release Site

Growth– NS


2012
N=107
Z
Y
N=9
Minto TR
Detroit HOR
2013
Y
Z
N=372
N=283
Detroit FB
Detroit HOR
2014
Z
Z
N=25
N=18
Detroit FB
Detroit HOR
Growth Rate (mm/d)
Release Site

Juvenile to Adult Survival

- MFW: 4 adult returns from 2011 releases (2TR, 2HOR), 7 adult returns from 2012 releases (2TR, 5HOR)

- NS: 6 adult returns from 2012 releases (3TR, 3HOR)

Key Points

No surprises; in general fish released above projects:

- Migrated slower to Willamette Falls=lentic environment and dam passage, reservoir fish usually delayed by month or longer
- Grew faster than the tailrace group=conducive reservoir growing conditions, possible long term survival advantage?

Key Points

No surprises; fish released above projects:

- Detected at a lower rate=consistent evidence of dam/reservoir impacts related to lower outmigration success; impacts appear to be greater in the MFW

- Effect sizes for differences in detections between Dexter TR and LOP HOR: 2011= 2.5:1, 60%
  2012= 5.14:1, 80.5%
  2013= 3.4:1, 70.6%
  2014= 16.78:1, 94%

- Effect sizes for differences in detections between Minto TR and Detroit HOR:
  2012= 1.17:1, 14.5%
  2013= 1.56:1, 36%
  2014= 1.64:1, 39%

Acknowledgments

- USACE - Rich Piaskowski, Greg Taylor, Todd Pierce, Doug Garletts, Chad Helms, Nathaniel Erickson et al.
- ODFW – Dan Peck & staff, Greg Grenbemer & staff, Fred Monzyk, Jeremy Romer, Ryan Emig, Kelly Reis, Kirk Schroeder, Suzette Savoie
- NOAA – Bill Muir (original concept)
- Biomark, Inc. – PIT tagging
- PSMFC – Tag recovery database
- PGE – Interrogation facility

Questions &
Discussion
http://oregonstate.edu/dept/ODFW/willamettesalmonidrme

Stayton and Bennett– NS

- 2014 NS releases detected: 2,976 TR, 744 FB, and 353 HOR
- Also detected at Willamette Falls: 162 TR (5%), 137 FB (18%), 52 HOR (15%)
- 2014 STW NS releases detected: 26 TR

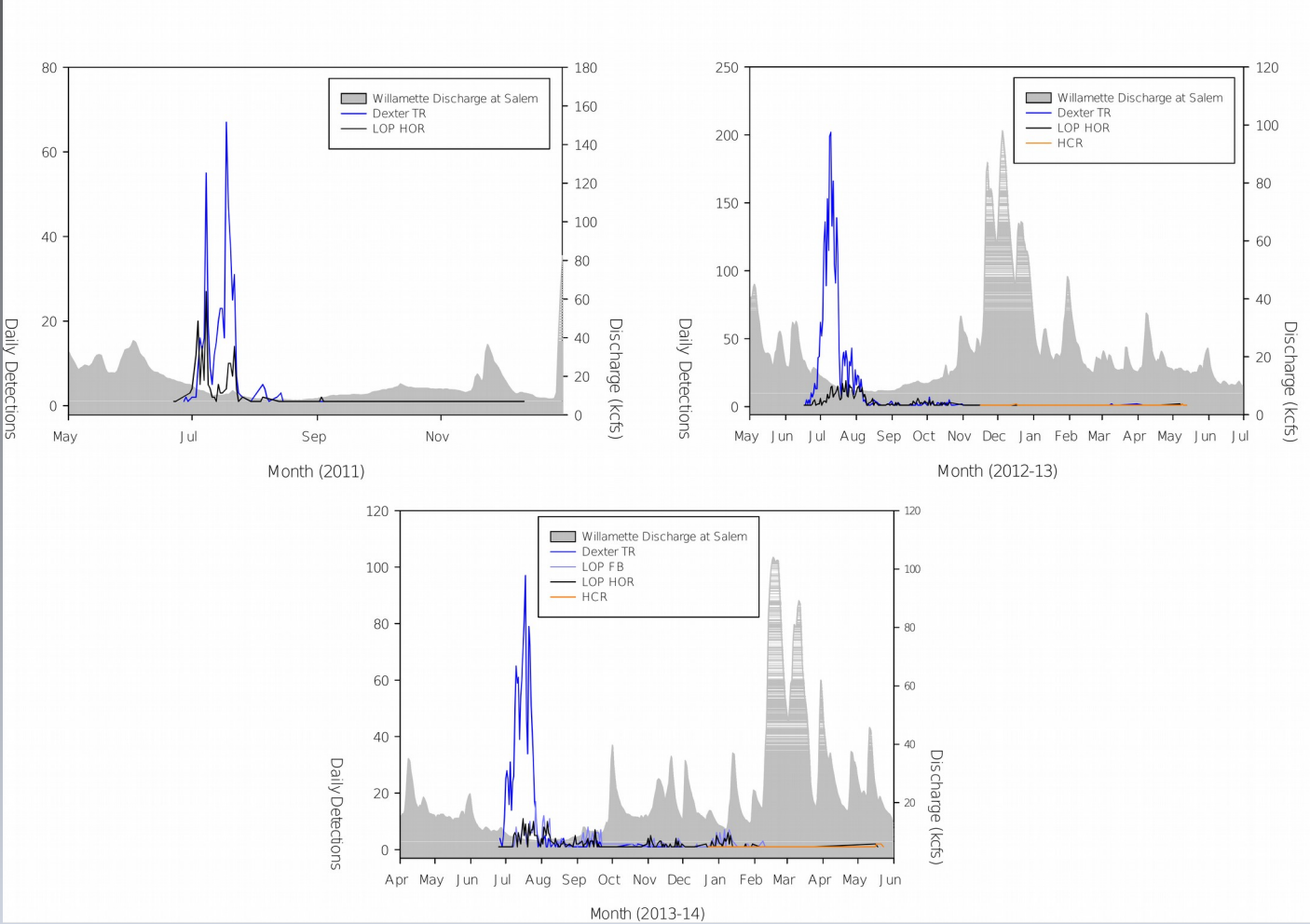
Fate

Anecdotal, but compelling case for substantial predation

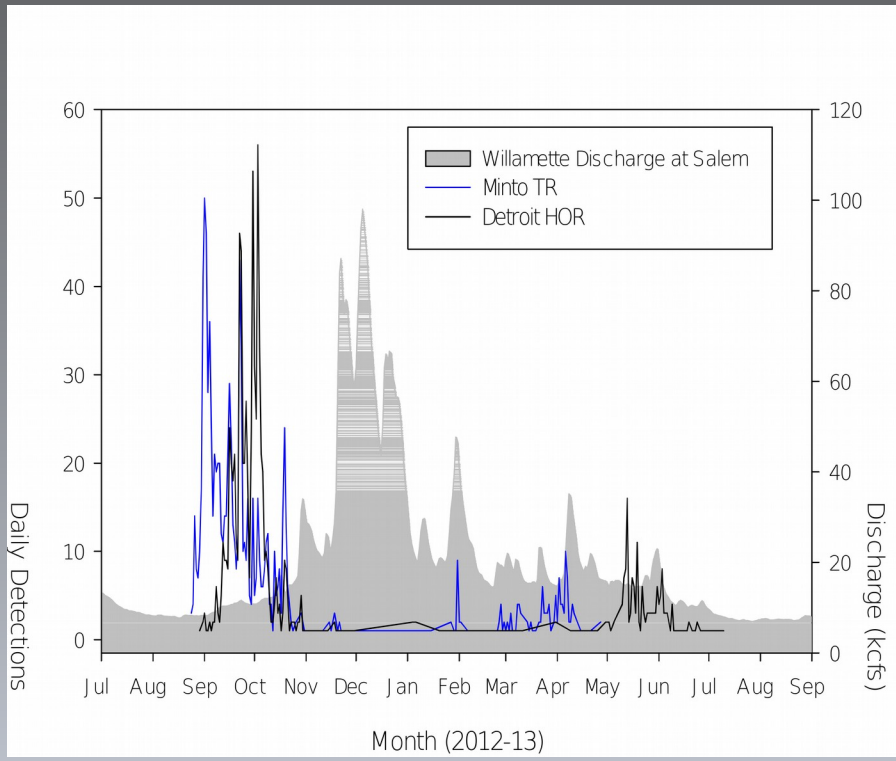
- MFW: 124 mortalities avian predation
- NS: 30 mortalities avian predation

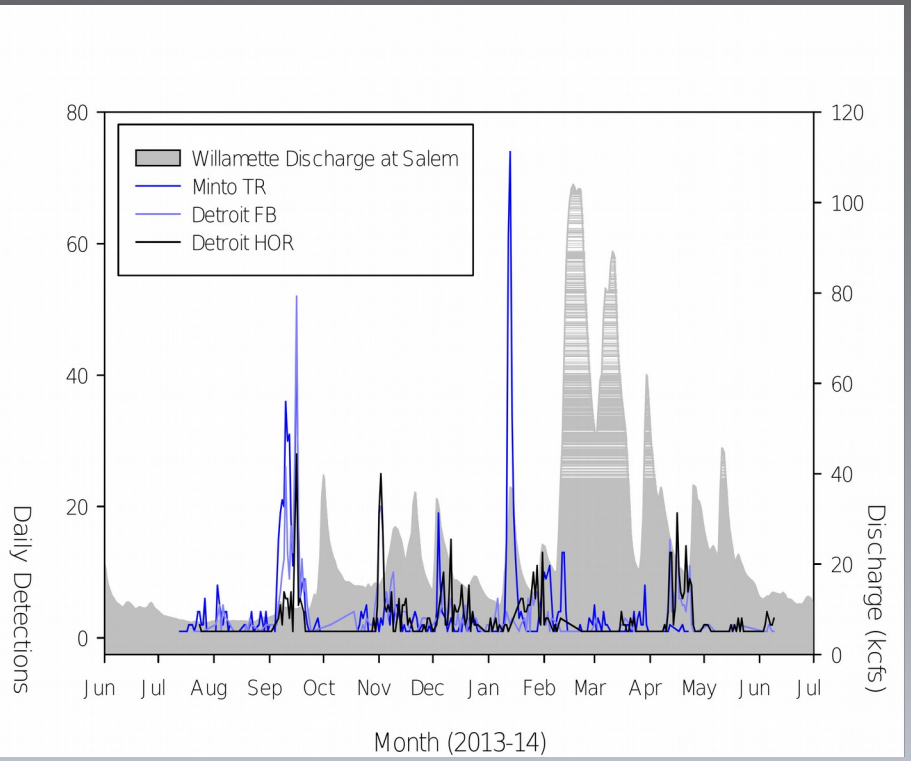
- MFW: 198 mortalities piscine predation
  - 158 from crappie
  - 18 from walleye
  - 11 from northern pikeminnow
  - 10 from largemouth bass
  - 1 from cutthroat trout

Detections and Discharge– MFW

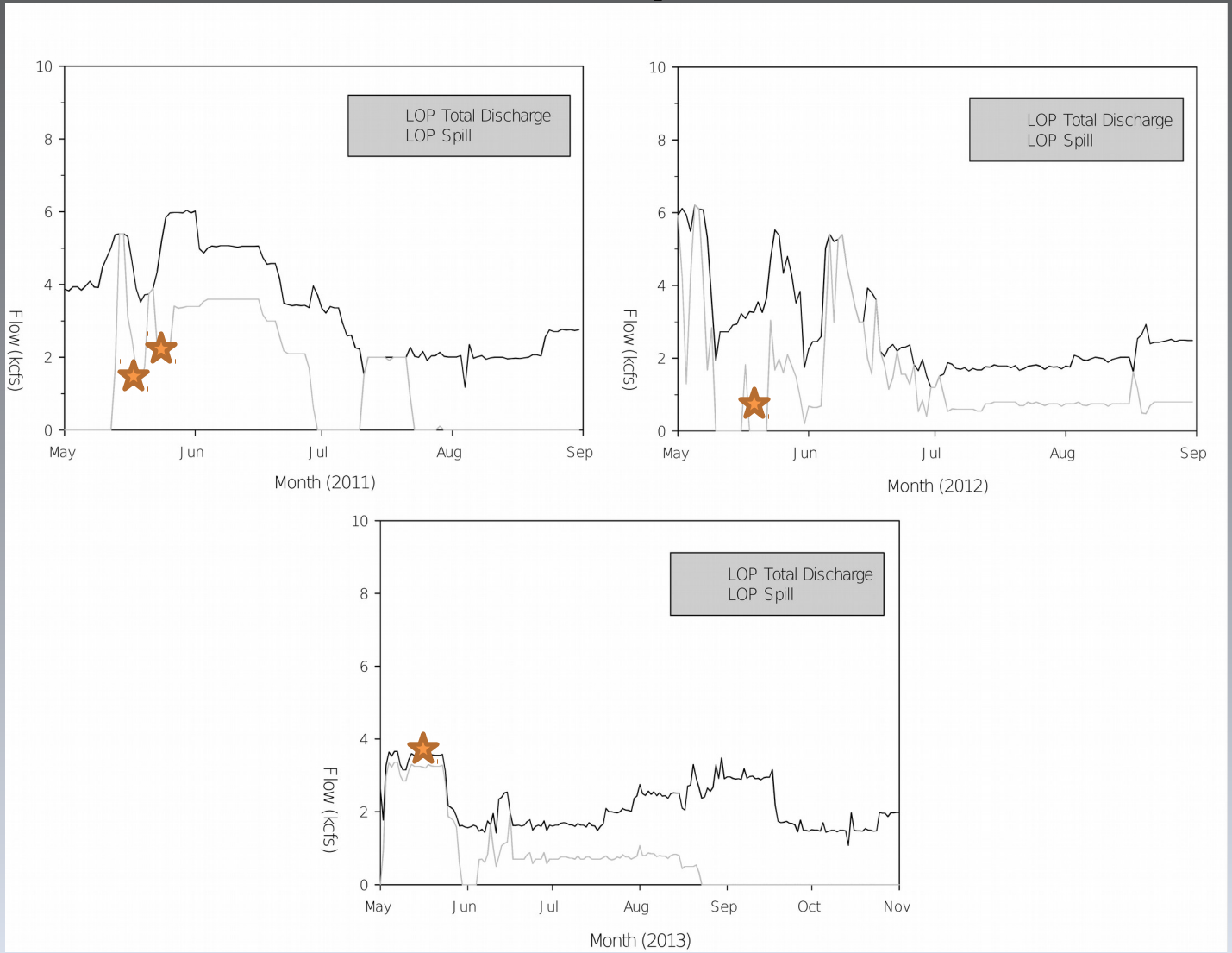


Detections and Discharge– NS

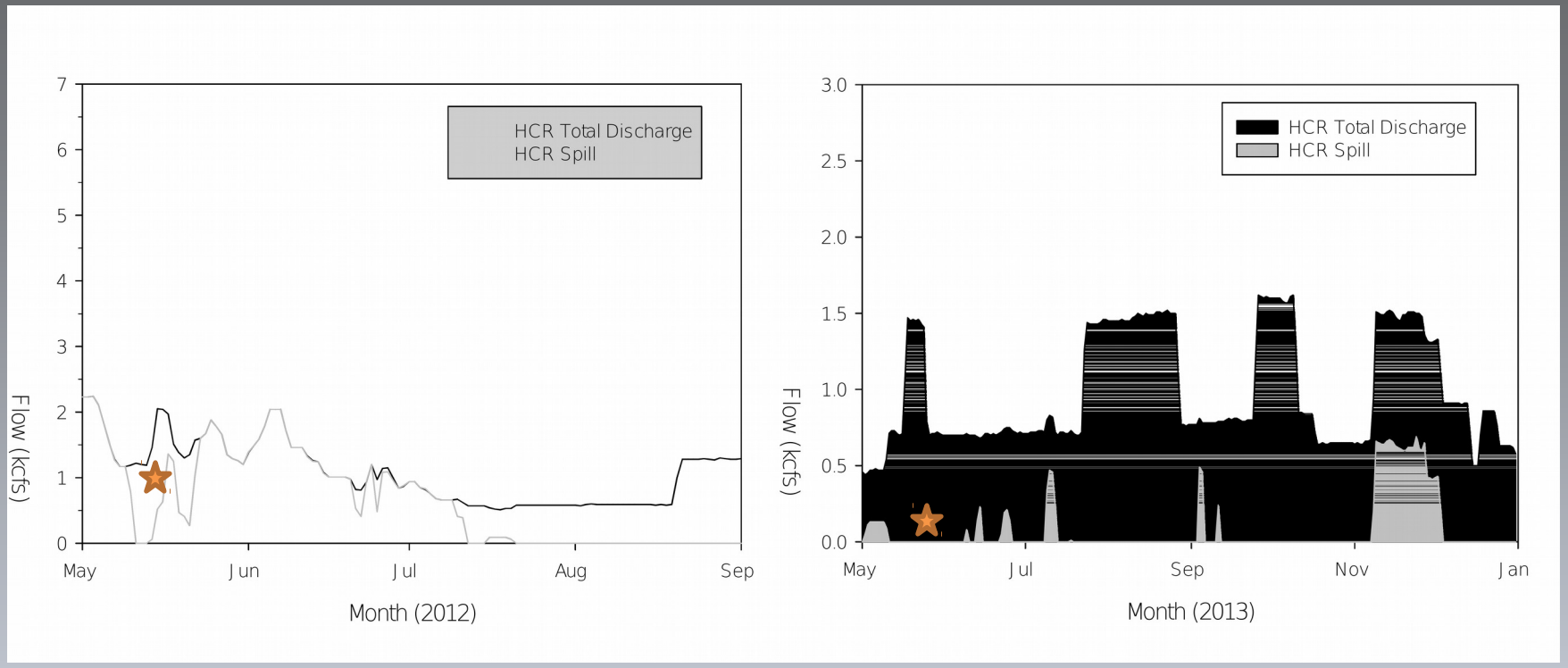

Willamette Discharge at Salem
Minto TR
Detroit HOR
Daily Detections
Discharge (kcfs)
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep
Month (2012-13)



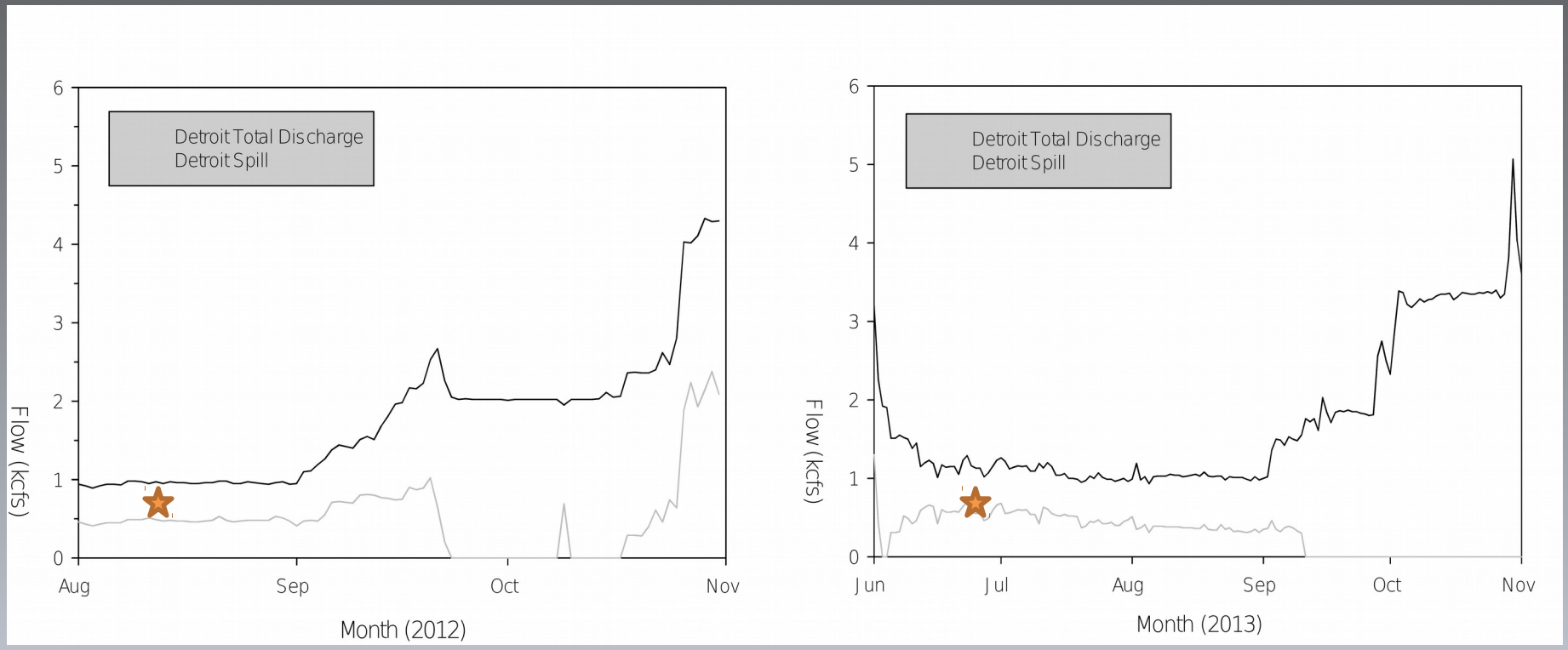
Effects of Dam Operations – LOP



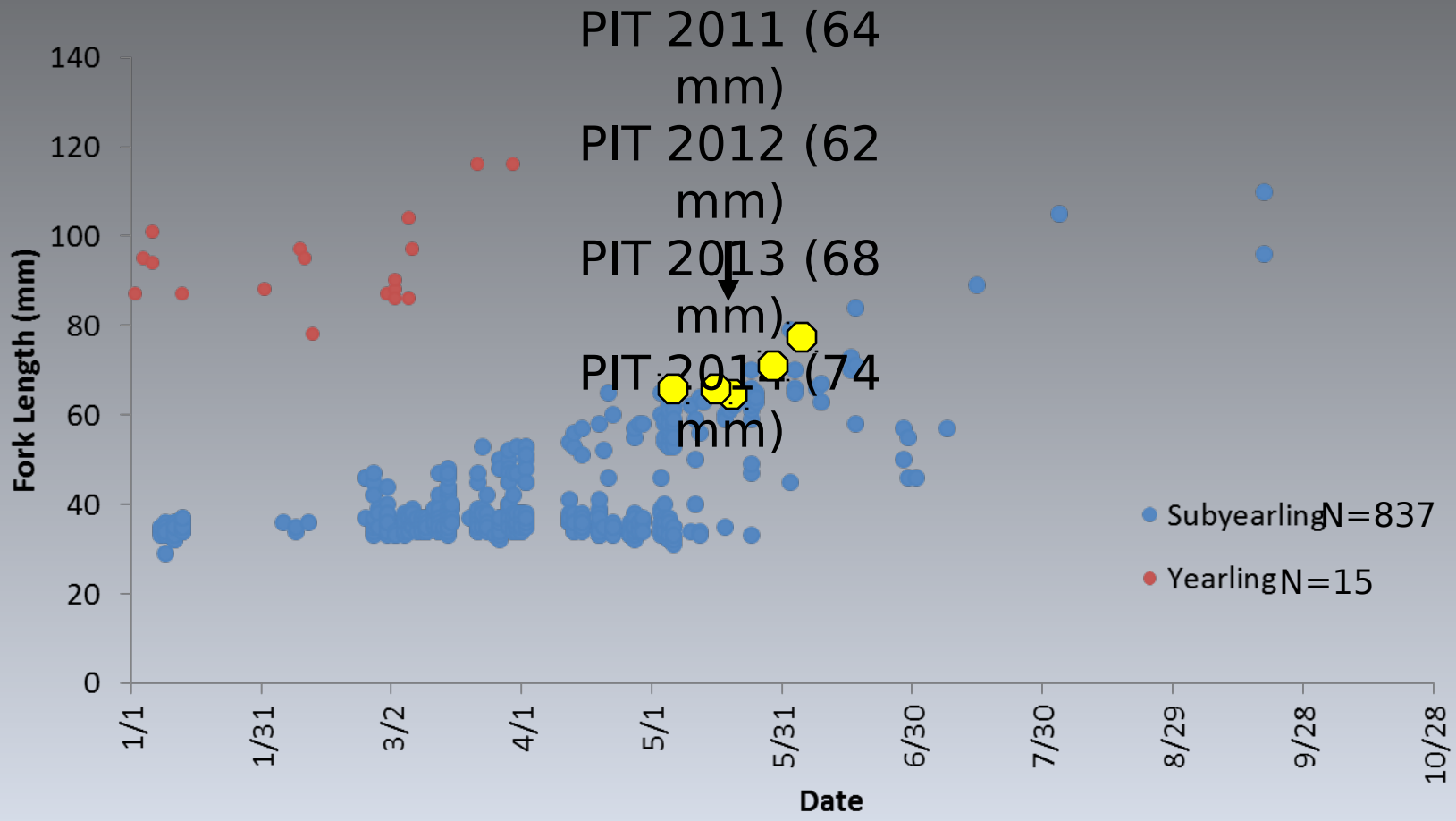
Effects of Dam Operations – HCR



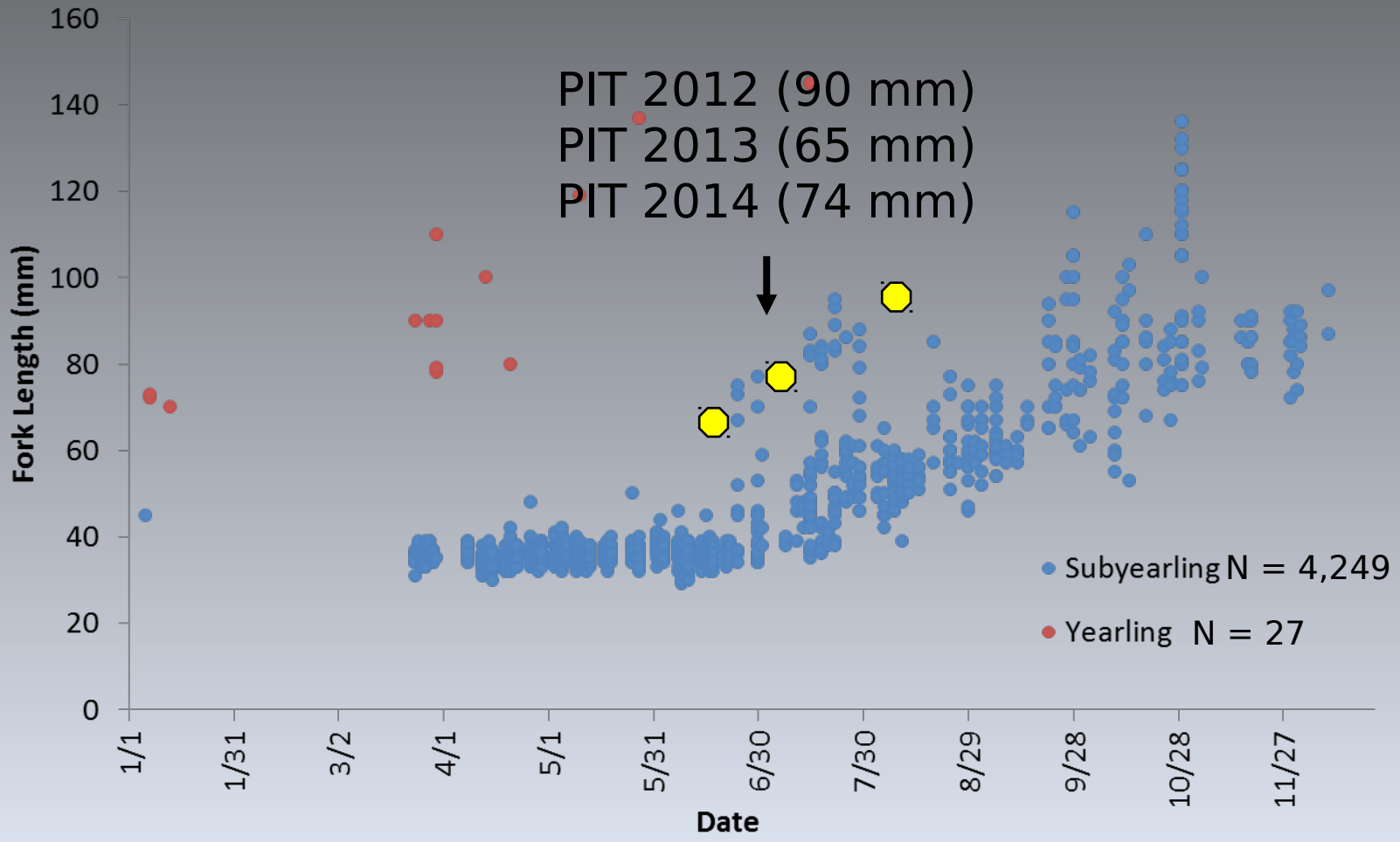
Effects of Dam Operations – Detroit



Lookout Point Reservoir entry, naturally-produced Chinook (Romer et al. 2012)



Detroit Reservoir entry, naturally-produced Chinook (Romer et al. 2012)



Movement Rate– MFW

Release Year	Release Location				
	Dexter TR	LOP TR	FB	HOR	HCR
2011	5.38^{A}	n/a	n/a	6.16^{A}	n/a
2012	5.82^{A}	n/a	n/a	4.70^{B}	0.99^{C}
2013	6.20^{A}	n/a	3.56^{B}	3.80^{C}	0.97^{D}
2014	6.95^{A}	2.68^{B}	2.76^{B}	2.88^{B}	n/a

Movement Rate– NS

Release Year	Release Location		
	TR	FB	HOR
2012	9.48^{A}	n/a	7.77^{B}
2013	1.49^{A}	1.68^{A}	1.31^{B}
2014	2.35^{A}	2.51^{A}	2.21^{B}

Growth– MFW

Release Year	Release Location				
	Dexter TR	LOP TR	FB	HOR	HCR
2011	0.65^{A}	n/a	n/a	0.73^{B}	n/a
2012	0.31^{A}	n/a	n/a	0.97^{B}	0.69^{B}
2013	0.47^{A}	n/a	0.89^{B}	0.90^{B}	0.64^{A}
2014	0.17^{A}	0.33^{A}	0.82^{B}	0.86^{C}	n/a

Growth– NS

Release Year	Release Location		
	TR	FB	HOR
2012	0.17^{A}	n/a	0.78^{B}
2013	n/a	0.71^{A}	0.68^{B}
2014	n/a	0.81^{A}	0.80^{A}